DOCUMENT RESUME

ED 082 841 PS 006 881

AUTHOR	Turnure, James; And Others
TITLE	Syntactic Elaboration in the Learning and Reversal of Paired-Associates by Young Children. Research Report #7.
INSTITUTION	Minnesota Univ., Minneapolis. Research, Development, and Demonstration Center in Education of Handicapped Children.
SPONS AGENCY	Bureau of Education for the Handicapped (DHEW/OE), Washington, D.C.
BUREAU NO	332189
PUB DATE	Jan 71
GRANT	OEG-09-332189-4533(032)
NOTE	58p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Cognitive Development; *Elementary School Students; *Learning Processes; *Paired Associate Learning; *Preschool Children; Retarded Children
IDENTIFIERS	*Syntactic Elaboration

ABSTRACT

Three studies were conducted to investigate the effects of extended syntactic elaboration conditions on paired-associate learning. Earlier studies have indicated that such conditions have facilitated paired-associate learning of retarded children. Study I involved 30 first grade children. As in previous studies, embedding stimuli to be associated in syntactic context, specifically, two-sentence paragraphs, facilitated acquisition and reversal of 4 paired-associates over a non-elaboration condition of labeling. Study II (with 36 first graders) demonstrated that two-sentence paragraph elaboration of two different types (semantic and syntactic) significantly facilitated paired-associate learning beyond that obtained by single sentence elaboration on an 8-pair list. No differences between the two types of paragraph elaboration with regard to acquisition and reversal were found nor were sex differences in performance evident. Study III explored developmental differences in relationships among verbal elaboration and non-elaboration conditions. Twenty four younger (3.8) and 24 older (4.9) nursery school children served as subjects. Data from all three studies were compared to findings of previous studies with retarded subjects. (DP)

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

ED 082841

SYNTACTIC ELABORATION IN THE LEARNING AND REVERSAL OF PAIRED-ASSOCIATES BY YOUNG CHILDREN[1]

James Turnure, Martha Thurlow and Sharon Larsen
University of Minnesota

Project No. 332189
Grant No. OE-09-332189-4533 (032)

Research Report #7

Research, Development and Demonstration Center
in Education of Handicapped Children
University of Minnesota
Minneapolis, Minnesota

January 1971

The research reported herein was performed pursuant to a grant from the Bureau of Education for the Handicapped, U.S. Office of Education, Department of Health, Education, and Welfare to the Center for Research, Development and Demonstration in Education of Handicapped Children, Department of Special Education, University of Minnesota. Contractors undertaking such projects under government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official position of the Bureau of Education for the Handicapped.

Department of Health, Education, and Welfare
U.S. Office of Education
Bureau of Education for the Handicapped

FS 006881

FILMED FROM BEST AVAILABLE COPY

RESEARCH AND DEVELOPMENT CENTER
IN EDUCATION OF HANDICAPPED CHILDREN
Department of Special Education
Pattee Hall, University of Minnesota, Minneapolis, Minnesota 55455

The University of Minnesota Research, Development and Demonstration Center in Education of Handicapped Children has been established to concentrate on intervention strategies and materials which develop and improve language and communication skills in young handicapped children.

The long term objective of the Center is to improve the language and communication abilities of handicapped children by means of identification of linguistically and potentially linguistically handicapped children, development and evaluation of intervention strategies with young handicapped children and dissemination of findings and products of benefit to young handicapped children.

Abstract

Three studies were conducted to replicate and extend the generality of the findings obtained previously with mentally retarded subjects of facilitated paired-associate learning under conditions of extended syntactic elaboration.

An initial study of 30 first-grade children indicated that with these normal subjects, as with the retarded of similar MA in previous studies, embedding stimuli to be associated in syntactic context, specifically two-sentence paragraphs, facilitates acquisition and reversal of four paired-associates over a non-elaboration condition of labeling.

Data obtained from a second study of first-grade children (N=36) demonstrated that two-sentence paragraph elaboration of two different types (semantic and syntactic) significantly facilitates paired-associate learning beyond that obtained by single-sentence elaboration on an eight-pair list. Backward associations were found to be remarkably good in all elaboration conditions, with no group scoring less than 97% correct on reversal. The two kinds of paragraph elaboration examined were found not to differ in their effects on acquisition or reversal. Sex differences in performance did not emerge.

A third study exploring developmental differences in relationships among verbal elaboration and non-elaboration conditions was undertaken with 24 younger (3.8 years) and 24 older (4.9) nursery children. The same two paragraph elaboration conditions used in the second study and the standard labeling condition were tested. Task difficulty was modified by using lists of four paired-associates.

Acquisition of associations in both paragraph elaboration conditions was significantly better than in the simple labeling condition. Performance was remarkably good: older subjects averaged only one trial beyond the level of perfect acquisition, and younger subjects averaged only two trials beyond perfect acquisition. This age difference was not statistically significant. Sex differences in this study, as in the first and second studies, were negligible. Backward association performance substantiated the general superiority of syntactic elaboration over labeling. Both elaboration conditions produced better reversal performance than labeling: the older paragraph groups achieved 97% correct and the younger 86% correct, while older and younger labeling subjects had 72% and 45% correct, respectively.

Data from these three studies were compared to similar data from previous studies with mentally retarded subjects.

Syntactic Elaboration in the Learning and Reversal of Paired-Associates by Young Children [1]

James Turnure, Martha Thurlow and Sharon Larsen

University of Minnesota

Two recent studies (Turnure & Walsh, 1971; Turnure, 1971) have reported the effects of extending syntactic mediation conditions of paired-associate learning beyond the previous limit of the single sentence by embedding the stimuli to be associated in two-sentence paragraphs. In the first experiment (Turnure & Walsh, 1971), the effects of Paragraph Mediation on the paired-associate learning of educable mentally retarded children was compared to the effects of Word Mediation and Sentence Mediation. The results showed paired-associate acquisition to be significantly superior for Sentence Mediation and Paragraph Mediation over Word Mediation, and showed Paragraph Mediation to be significantly superior to Sentence Mediation.

The results of a reversal manipulation demonstrated that syntactic mediation also dramatically facilitates backward associations. Word Mediation reversal scores were significantly inferior to Sentence and Paragraph Mediation reversal scores, but the latter two did not differ. It was noted that as many as 90% of the subjects in the sentence and paragraph conditions learned and reversed the associations without committing a single error, which appeared to be phenomenal performance considering that these were retarded learners. In a second study (Turnure, 1971), list length was increased and item placement within two different Paragraph Mediation conditions was investigated. Despite these manipulations, the findings from the

second study on acquisition and reversal strongly supported the previous results.

The present series of studies constitutes an attempt to replicate and extend the generality of findings obtained with mentally retarded subjects to a population of "normal" individuals. A related aim of the present research was to gather data suitable for comparative evaluations of normal and retarded children's performance on these verbal tasks. To this end the normal children tested in Studies I and II were selected to constitute roughly matched MA comparison groups for the retarded subjects tested previously (Turnure & Walsh, 1971; Turnure, 1971).

In Study I, first-grade children approximately seven years of age were tested in either one of two paragraph elaboration conditions (designated Semantic and Syntactic) or a Word Mediation condition; list length was four pairs.[2] In Study II, first-grade children served as subjects again, and were observed in either one of the two paragraph conditions or a Sentence Elaboration condition; list length was increased to eight pairs. In Study III the subjects were preschool children ranging in age from three to five years. This study included both paragraph conditions and the Word Mediation condition, and the list length was four pairs.

Study I

Study I constitutes a partial replication of the Turnure studies (Turnure & Walsh, 1971; Turnure, 1971), and was designed to determine if some of the results from these studies were replicable and of fairly broad generality. Of particular interest was the wide disparity in performance between Word Mediation subjects and Paragraph Elaboration subjects, with the latter subjects

performing better on both acquisition and reversal of the paired-associate items. While the extraordinary efficacy of syntactic mediation over simple labeling in the paired-associate task was well documented with both normal and retarded subjects (cf. Davidson, 1964; Jensen & Rohwer, 1963a; 1963b; Milgram, 1968a,b, c), these results had been restricted to conditions employing grammatical phrases or whole sentences and had been obtained only on acquisition. Past research, then, provided good reason to predict that acquisition results obtained previously with the paragraph and word mediation procedures designed by Turnure and Walsh would be replicable and generalizable. However, the findings from their reversal manipulation were necessarily still limited to the retarded population in which they were originally observed, and therefore the generality of the reversal results would be important to determine.

The subjects selected for study were normal children of an MA level comparable to that of the retarded subjects used previously (Turnure & Walsh, 1971). The assumption here, of course, was that the MA level of the original retarded subjects represented a level of intellectual attainment sufficient to allow for the results, i.e., the results were not restricted to children who had attained the CA level of the retarded subjects originally tested.

Except for the change in subject category, no new manipulations were introduced in the present study. The subjects were tested in either the standard Word Mediation condition or in one of two paragraph elaboration conditions. In one condition, called Syntactic Paragraph, the stimulus term was embedded in the first sentence of the two-sentence paragraphs and the response term in the second.

In the other condition, designated Semantic Paragraph, the stimulus and response terms were both placed in the first sentence, and the second sentence provided semantic elaboration. There appeared to be little or no theoretical basis for predicting the relative effectiveness of the two paragraph types, and no differences between the two types had been found by Turnure (1971).

Method

Subjects. Thirty first-grade children attending a public elementary school in Minneapolis, Minnesota were tested. Subjects selected had been judged by their teachers to be of average intelligence and had scored between the 36th and 69th percentile on the Metropolitan Reading Readiness Test. Subjects were matched on CA, Metropolitan test scores, and sex, and then randomly assigned to one of three conditions. Means and ranges for the three groups are shown in Table 1. Equal numbers of boys and girls were assigned to each condition.

Materials. The stimulus materials consisted of eight pictures of common objects which had been cut out of pre-primer workbooks and individually mounted on white cardboard (3.5 x 2.5 in.). The pictures and the four pairings made were from those used by Turnure and Walsh (1971).

Procedure. Three experimental conditions were used: Word Mediation and two paragraph elaboration conditions, Semantic Paragraph and Syntactic Paragraph. The two paragraph conditions were similar to those used by Turnure (1971) to provide a test of the effects of different placement in the paragraphs of the stimuli to be associated.

A single training trial was given initially in all three conditions.

TABLE 1

Means and Ranges of CA's and Metropolitan

Test Scores for Experimental Groups - Study I

Word Mediation:

CA $\overline{X}$ = 7.1 range = 5.6 - 7.5

Metro. Test $\overline{X}$ = 55.8 range = 40 - 69

Semantic Paragraph:

CA $\overline{X}$ = 6.9 range = 6.6 - 7.1

Metro. Test $\overline{X}$ = 54.2 range = 42 - 65

Syntactic Paragraph:

CA $\overline{X}$ = 7.0 range = 6.4 - 7.5

Metro. Test $\overline{X}$ = 50.7 range = 36 - 68

ED 063871

The experimenter covered each response picture with the card bearing the corresponding stimulus item and then exposed both pictures together for seven seconds. The experimenter then said something about the pictures being exposed. In the Word Mediation training trial, the subject was required to repeat after the experimenter the names of the two pictures being exposed. In the Semantic Paragraph training trial the subject was required to repeat a two-sentence paragraph in which the names of the stimulus and response both occurred in the same sentence (e.g., "Hit the crayon with the hammer. That will break it."). In the Syntactic Paragraph training trial, subjects were also required to repeat two-sentence paragraphs, although in this condition the stimulus word and the response word occurred in different sentences (e.g., "See the wagon. It is full of scissors.").

In each of the three conditions the training procedure was carried out once for each of the four stimulus-response pairs. In all conditions the verbal elaborators were not repeated by the experimenter after the training trial; if the subject continued to repeat them in the subsequent learning task, he was told to name only the response item in each pair.

After the training trial, subjects in all conditions were given the same learning task utilizing standard paired-associate anticipation procedures. The stimulus picture of each pair was presented for approximately three seconds and the subject was asked to identify the picture (response term) hidden behind it. If an incorrect response was given, or if after three seconds no response was made, an error was scored. After the subject had responded or three seconds had passed, the experimenter removed the stimulus picture to expose the picture behind

it. The two items were shown together for five seconds, and then the next stimulus item was presented. Presentation of the four stimulus-response pairs in this manner was termed one trial. In order to rule out positional cues, the experimenter randomly changed the order of presentation of the four pairs in each trial. Speed of learning was expressed as the number of trials to a criterion of two successive errorless trials up to a maximum of 20 trials.

Immediately after criterion had been reached (or 20 trials had been presented) the stimulus and response items of the pairs were reversed. The subject was not told of the reversal and the task continued as if no alteration had taken place. Each subject was given two reversal trials which were scored in terms of the number of correct responses given by the subject.

Results

Results of the acquisition phase of the study are reported in terms of trials to a learning criterion of two consecutive errorless trials. Scores could range from 2 to 20; a perfect performance would be represented by a score of 2. Mean trials to criterion for three conditions, for both male and female subjects, are shown in Table 2. This table indicates that there was little difference between the boys and the girls in any condition. The trials to criterion scores for the Word Mediation group are, however, clearly higher than those of either of the two paragraph conditions, both of which show means extremely close to 2.

The extreme skewness of the scores in the paragraph conditions prohibited the use of parametric statistics in analyzing the data. Therefore, a test of the proportion of subjects making errors in the

TABLE 2

Mean Scores for Acquisition and Reversal- Study I

	Acquisition- Trials to Criterion			Reversal- Number Correct		
	Boys	Girls	Combined	Boys	Girls	Combined
Word Mediation:						
$\bar{X}$	10.2	8.8	9.5	5.8	6.0	5.9
SD	5.9	4.3	4.9	1.9	1.4	1.6
Semantic Paragraph:						
$\bar{X}$	2.0	2.6	2.3	7.8	8.0	7.9
SD	0.0	0.9	0.7	0.4	0.0	0.3
Syntactic Paragraph:						
$\bar{X}$	2.0	2.0	2.0	7.6	8.0	7.8
SD	0.0	0.0	0.0	0.5	0.0	0.4

Word Mediation condition (proportion = 1.00; n = 10) versus the proportion of subjects making errors in the paragraph conditions combined (proportion = .10; n = 20) was made, and a significant difference between the groups was found (Z = 16.36, $p < .001$).

The scores on the reversal phase of the study showed virtually no differences between male and female subjects (see Table 2). Reversal scores were also radically skewed and the criterion of errorless performance was again applied to subject performance in order to provide incidence figures suitable for non-parametric analyses. A test of the proportion of subjects in the Word Mediation condition who made at least one error (proportion = .80; n = 10) versus the proportion in the combined paragraph conditions (proportion = .15; n = 20) was significant (Z = 6.67, $p < .01$). A chi-square test of subjects making no errors on the reversal in the two groups just described substantiated the difference indicated by the test of proportions (x^2 = 9.49, df = 1, $p < .01$).

Discussion

The results of this study indicate that with young normal children, as with the retarded children of similar MA (6.5 years) in both of the Turnure studies reported previously (Turnure & Walsh, 1971; Turnure, 1971), embedding of the stimuli to be associated in a syntactic context facilitates acquisition performance over conditions of restricted, non-syntactic word mediation. Similarly, significantly more subjects reversed perfectly in the combined paragraph conditions (90%) than in the Word Mediation condition (20%). Thus, the results confirm the replicability of the findings reported in the Turnure and Walsh study (1971) and extend their generality into the population of normal

children of MA (and CA) 6.5 years of age. Finally, there did not appear to be any superiority of one paragraph condition over the other for either acquisition or reversal, although the presence of a floor effect in the data precludes drawing any conclusions to that effect.

The present study, however, did not include a Sentence Mediation condition as did Turnure and Walsh (1971) and Turnure (1971). In those studies with educable mentally retarded children, paragraph elaboration conditions were found to be superior to Sentence Elaboration for both acquisition and reversal, and both Sentence and Paragraph Elaboration significantly facilitated paired-associate learning over Word Mediation. Although there is no apparent reason to suspect that the relative efficacy of Word Mediation and Sentence and Paragraph Elaboration should be different for normal subjects than for retarded subjects of similar MA's, the possibility that differences may exist was tested in a subsequent study with normal first graders.

Study II

In the second study of this series with young normal children, a Sentence Elaboration condition was compared with two paragraph elaboration conditions identical to those used in Study I. A Word Mediation condition was not included as it seemed sufficiently evident that the normal children performed significantly poorer under a condition of non-syntactic mediation, as did the retarded. In the present study list length was extended to eight pairs to permit comparisons between the performances of the normal subjects here and the retarded subjects of the second Turnure study (1971). This earlier study had found that the efficacy of syntactic elaboration over

labeling and of paragraph elaboration over sentence elaboration was maintained despite the increased memory load resulting from expansion of the list length. Similar findings were expected in the present study.

Method

Subjects. Thirty-six first grade children from a suburban Minneapolis public school were used. Since no standardized test results were available, teachers were asked to provide class lists which excluded those children whom they considered to be at high or low ability extremes. From these lists six girls and six boys were randomly assigned to each of the three experimental conditions. Mean CA's and ranges for subjects in each condition were: Sentence Elaboration $\overline{X}$ = 7.1, range 6.7 - 7.4: Syntactic Paragraph : $\overline{X}$ = 7.1, range 6.7 - 7.8: Semantic Paragraph: $\overline{X}$ = 7.2, range 6.7 - 7.6.

Materials. The stimulus materials consisted of 16 pictures of common objects similarly obtained and mounted as in Study I. Eight stimulus-response pairs were formed from this set of stimulus materials. The pictures and the pairings, as well as the sentence and paragraph elaborators, were taken from Turnure (1971).

Procedure. Experimental procedures for the two paragraph elaboration conditions were similar to those used in Study I. A single training trial in which the experimenter exposed both pictures together for approximately seven seconds was given initially. During this period the experimenter said a two-sentence paragraph (of either the semantic or syntactic type) which the subject was required to repeat. In the Sentence Elaboration training trial, the subjects were required to repeat a short sentence relating the stimulus and response objects

while looking at the two pictures being held before him (e.g. "The cup has soap in it."). In each of the three conditions the training procedures were carried out once for each of the eight stimulus-response pairs. The pairs of pictures and their order of presentation in these training trials were identical for all three conditions.

Following verbal elaboration training trials, learning trials were begun. As in Study I, the stimulus picture of each pair was presented and the subject was asked to identify the picture (response term) that was hidden behind it. Subjects were permitted to take up to one minute to respond, if necessary. This increase in the amount of time allowed for response over that permitted in Study I seemed necessary in light of increased task difficulty. After a response the experimenter exposed both pictures together for five to ten seconds, and then removed the pair. One trial consisted of the presentation of the eight pairs in this manner. The order of presentation of the eight pairs across trials was predetermined by random assignment, but the same order was used for every subject. Learning to criterion was again defined in terms of two errorless trials and the above procedure was continued until criterion was reached.

Two reversal trials (16 pairs) were given immediately after criterion was reached. The procedure was identical to that of Study I.

Results

Acquisition scores for Study II are reported in terms of trials through a learning criterion of two consecutive errorless trials, i.e., at least 16 consecutive correct responses. Mean trials to criterion for the three experimental groups are presented in Table 3. A Condition x Sex analysis of variance performed on the trials to criterion data

TABLE 3

Mean Trials to Criterion and Percentage of

Subjects with Perfect Acquisition Performance-Study II

	Trials to Criterion		Perfect Acquisition	
	$\bar{X}$	SD	n	%
Sentence Elaboration	4.25	1.82	3	25
Semantic Paragraph	2.92	0.79	4	33
Syntactic Paragraph	2.33	0.65	9	75

produced only a significant conditions effect ($F = 7.82$; $df = 2,30$; $p < .005$). The sex variable and the Condition x Sex interaction were not significant. Overall condition effects were tested further by means of critical differences t tests. These analyses indicated that both the Syntactic Paragraph and Semantic Paragraph conditions significantly differed from the Sentence Elaboration condition (both p's $< .05$), although differences between the two paragraph conditions were not significant.

The number and percentage of subjects who performed perfectly (i.e., trials to criterion = 2.0) in each group can also be seen in Table 3. A chi-square analysis of these data was significant ($x^2 = 6.96$, $df = 2$, $p < .05$). A chi-square analysis of these data for the two paragraph conditions only was also significant ($x^2 = 4.20$, $df = 1$, $p < .05$).

The groups' mean number correct on reversal trials can be seen in Table 4. It is evident from these results that performance on reversal was not only very similar among all conditions, but in each case nearly approached the maximum number correct (16). In fact, only one subject in the Sentence Elaboration condition made 2 errors; all other subjects in all conditions made 1 or 0 errors. Analysis of these data seemed pointless. The number and percentage of subjects reversing perfectly is also shown in Table 4.

Discussion

The results of Study II clearly indicated that either syntactic or semantic paragraphs significantly facilitate acquisition of paired-associates beyond that of sentence elaboration. The two kinds of paragraphs examined were not found to differ, except that more subjects

TABLE 4

Mean Number Correct on Reversal and Percentage of Subjects with Perfect Reversal Performance-Study II

	Number Correct		Perfect Reversal	
	$\bar{X}$	SD	n	%
Sentence Elaboration	15.50	0.67	7	58
Semantic Paragraph	15.92	0.29	8	67
Syntactic Paragraph	15.67	0.49	11	92

performed errorlessly in the Syntactic Condition than in the Semantic (where six subjects made a single error on the first or second trial). The performance of boys and girls did not differ in any significant way. These latter findings exactly replicate those of Study I and the prior findings of Turnure (1971).

Despite the fact that differences were found in the present study between the Sentence Elaboration and the paragraph elaboration conditions, both groups showed very rapid learning: the Sentence Elaboration group averaged only 4.25 trials to criterion whereas the paragraph elaboration groups produced mean performances very near to the minimum number of trials possible (see Table 3). The expanded list length had only minimal effects on the acquisition performance of these normal first graders under conditions of paragraph elaboration. A comparison of mean acquisition performance of these subjects in Study II (Table 3) with that of the paragraph elaboration subjects in Study I (Table 2) reveals that means were only very slightly greater for the subjects who had been required to learn double the number of stimulus-response pairs. Precisely the same observation was made for the educable mentally retarded subjects who performed with 4 pairs and 8 pairs in the Turnure and Walsh (1971) and Turnure (1971) investigations, respectively. Thus, the effects of even longer list lengths needs to be tested.

The enhanced facilitation associated with paragraphs over sentences found in Study II does not seem to be readily explainable. Certainly these findings, along with the lack of any apparent superiority of the Semantic Paragraph condition over the Syntactic Paragraph condition in both studies I and II, raise questions concerning the

adequacy of attempts to explain the effects of syntactic elaboration by reference to the internal integrity of sentences' syntactic structures alone (Blumenthal, 1967; Blumenthal & Boakes, 1967; Suzuki & Rohwer, 1969). Also, the short simple paragraphs used do not seem to be more obviously meaningful than the single sentences made available to the subjects. While it would be premature to contend that extensions of syntactic models could not account for the effects being discussed, or to argue that meaningfulness (semantics) is irrelevant, grounds exist for developing an alternative interpretation. This interpretation requires that more general requirements of the task be considered as partial determinants of the results, instead of focusing only on the content of the verbal stimuli or their underlying grammatical structure.

Jenkins (1967) has recently suggested that paired-associate learning constitutes a "series of tasks which must be accomplished by the subject [p. 48]." Jenkins describes the initial task facing the subject as that of understanding the requirements of the learning task and getting a "feel" for the procedures. This analysis suggests a "communication hypothesis," which may be stated: If, in the procedures of the present studies, the paragraph elaboration conditions better satisfied the task requirements for the subjects, presumably by better approximating the usual or familiar circumstances wherein they associate objects, a positive increment in acquisition would be expected. Jenkins (1967) has pointed out that such general task variables "are important in producing the first increment in 'learning to learn' and 'warm up' phenomena so readily obtained in the laboratory [p. 49]." Thus, the absence of any evidence of learning to learn or warm up in

the paragraph elaboration conditions of these studies, where learning was virtually immediate, constitutes evidence in support of the communication hypothesis. Furthermore, the hypothesis could be tested by devising procedures to establish optimal communication with sentence elaboration subjects, thereby eliminating differences in acquisition between sentence elaboration and paragraph elaboration groups. The necessary procedures might include extensive instructions, and/or pretraining (Taylor, 1970), to explicate precisely the requirements of the task.

The primacy of psycholinguistic interpretations of meaningful paired-associate learning has also been challenged recently by several theorists whose very general explanations of the enhancement of paired-associate learning in meaningful contexts may be pertinent to the particular sentence versus paragraph differences being discussed. One approach emphasizes the role of imagery (Bower, 1970, Paivio, 1970); another the "psychology of relations" (Asch, 1969). Given the method of the present study, especially considering the equal availability of identical pictures (i.e., equivalent image-evoking manipulations) in each condition, an explanation of the sentence - paragraph differences in terms of imagery would necessarily focus on whether, or the degree to which, each type of elaboration condition evoked "interactive imagery," which, as Bower (1970) has observed, involves simultaneous consideration of images and relations. Observation of sample sentences and paragraphs (see Procedures, Studies I and II) indicates that item interaction is suggested in all elaboration conditions, but it is not clear that a greater degree of item interaction is implied by the paragraphs.

The only clear and certain physical difference that appears to exist between the sentences and paragraphs used in this study is that the paragraph condition contains a second sentence comprising a sensible continuation of the meaning of the first. Bobrow and Bower (1969) have recently demonstrated that requiring subjects to produce sentences which were sensible continuations of a sentence initially provided strongly facilitated recall of predicate nouns from the initial sentences, given the subject nouns of those sentences as retrieval cues. Apparently, consideration of stimulus items in extended verbal contexts directly enhances the subject's comprehension (Anderson, 1970; Bobrow & Bower, 1969) of their relations, producing distinctive effects on acquisition (Asch, 1969). Of course, the difference between the different types of extended verbal conditions just discussed and the labeling condition would be due to the absence of any meaningful relations (Asch, 1969) between items in the labeling condition.

As for reversal performance, doubling the pairs apparently had no detrimental effect, since in Study II as in Study I reversal performance of paragraph elaboration subjects was nearly perfect. Furthermore, Study II results indicate that Sentence Elaboration had an equivalent effect on reversal performance in that it also resulted in nearly perfect reversal performance (cf. Turnure & Walsh, 1971; Turnure, 1971).

The lack of any differences in the reversal performance of the sentence and two paragraph conditions indicates that once the organization and storage of meaningfully related items in memory is achieved, they are readily available for retrieval and use in any sequence irrespective of the context of acquisition. This ready and flexible

availability allows for the immediate reordering of referential terms (items) as required by transformational grammars (cf. Turnure & Walsh, 1971). However, the question remains as to whether, or how, transformations function across sentence boundaries in such a way as to allow the findings from the paragraph conditions to be subsumed under this theoretical analysis. An alternative would be to consider the ready reversibility of items acquired in paragraphs as a separate, but parallel, outcome of relational organization, either as discussed above or by Asch and Ebenholtz (1962) in regard to their notion of conceptual symmetry.

The findings of these two studies with normal subjects closely and remarkably parallel those of the two Turnure studies with educable mentally retarded children of similar MA's (Turnure & Walsh, 1971; Turnure, 1971). For both subject groups, the order of magnitude of the results was stable despite increased task difficulty. Exact comparisons are not possible as both Word Mediation and Sentence Elaboration conditions were not used in the longer list study reported here. It does seem evident, however, that paragraph elaboration facilitates performance more than either sentence elaboration or labeling for normal as well as retarded children of MA 6.5. Also, increased task difficulty, so far as has been tested in these studies, has only a minimal effect.

Study III

A third study in this series was undertaken to explore possible age effects on the relationships among verbal elaboration conditions which had appeared with both the normal and retarded children of MA 6.5. In Study III children of two younger CA groups were tested in either

the Word Mediation condition or one of the two paragraph elaboration conditions. The two groups of children selected for this study were from a high IQ, university nursery school population (IQ's approximately 120, by principal's estimate), and although both the oldest and the youngest of the two groups were younger chronologically than the normal subjects of Studies I and II, the oldest group provided a rough MA match with those normal subjects and also with the retarded subjects of the Turnure studies (Turnure & Walsh, 1971; Turnure, 1971).

The youngest subjects in Study III, whose CA's ranged as low as three years, three months, appear to be the youngest children for whom the efficacy of syntactic elaboration over labeling has been tested to date. They thus represent a sample of more than passing interest, as it might be expected that such young children, just at the end point of developing a complete syntactic system (Ervin & Miller, 1963; McNeill, 1966), might not yet be so fully competent in its' usage. In other words, these children might not show the facilitation in performance on the task employed that has been found in previous work with older, more experienced and practiced children. In particular, the kind of verbal flexibility required of subjects for successful performance in the reversal phase of testing might be overtaxed, so that they would show little, if any, performance facilitation in conditions of syntactic elaboration over that in labeling conditions. The decision to include separate Syntactic Paragraph and Semantic Paragraph elaboration conditions also involved the presumption that the involvement of relatively inexperienced subjects would allow a more sensitive test for differences in the performances of children as a function of the two different verbal constructions. A Sentence Elaboration condition was not included primarily because of a shortage of available subjects.

Method

Subjects. The subjects were 48 nursery school children enrolled in the nursery school at the University of Minnesota. Subjects of the same sex and age group ("young" and "old") were randomly assigned to one of the three experimental conditions. Thus, there were four subjects in each of the twelve cells in a 3 (conditions) x 2 (sex) x 2 (age) design. The mean CA and standard deviation of each of the groups is presented in Table 5.

Materials and Procedures. The same three experimental conditions were employed in Study III as in Study I: Word Mediation, Semantic Paragraph and Syntactic Paragraph Elaboration. As in Study I the stimulus materials consisted of eight pictures of common objects, and the pictures and four pairings made were from those used by Turnure (Turnure & Walsh, 1971; Turnure, 1971). The procedures were identical to those used in Study I with the following exception: During the learning trials, the stimulus picture of each pair was presented for as long as 30 seconds while the subject was attempting to identify the picture hidden behind it (the response picture). If an incorrect response was given, or no response was initiated within this time, an error was scored. This longer response time was felt to be necessary in view of the younger age of the subjects being tested.

Results

Again the results of the acquisition phase of the study are reported in terms of trials through a learning criterion of two consecutive errorless trials, here eight consecutive correct responses. Table 6 presents mean trials to criterion and standard deviations for

TABLE 5

Mean CA's and Standard Deviations of Experimental Groups - Study III

	Boys		Girls		Combined	
	Young	Old	Young	Old	Young	Old
Word Mediation:						
$\bar{X}$	3.70	4.95	3.88	4.95	3.79	4.95
SD	0.39	0.29	0.38	0.53	0.37	0.39
Semantic Paragraph:						
$\bar{X}$	3.58	5.03	4.03	4.80	3.80	4.91
SD	0.26	0.15	0.21	0.08	0.33	0.16
Syntactic Paragraph:						
$\bar{X}$	3.78	4.98	3.90	4.90	3.80	4.94
SD	0.36	0.32	0.36	0.29	0.34	0.29

TABLE 6

Mean Trials to Criterion - Study III

	Boys		Girls		Combined	
	Young	Old	Young	Old	Young	Old
Word Mediation:						
$\bar{X}$	10.75	6.25	10.25	9.25	10.50	7.75
SD	6.24	5.85	6.70	7.23	6.00	6.30
Semantic Paragraph:						
$\bar{X}$	3.00	3.50	3.25	2.50	3.13	3.00
SD	1.41	1.29	1.96	0.58	1.55	1.07
Syntactic Paragraph:						
$\bar{X}$	4.00	2.25	3.50	2.25	3.75	2.25
SD	2.45	0.50	1.25	0.50	1.83	0.46

each experimental group in Study III. Observation of Table 6 suggests that in this study, as in Studies I and II, differences between sexes were negligible. The mean trials to criterion scores for the Word Mediation group are clearly higher than those for either paragraph elaboration condition. It appears that older subjects on the whole performed slightly better than did younger subjects. The statistical significance of these apparent differences was tested by a Condition x Sex x Age analysis of variance. Only the conditions effect was found significant in this analysis (F = 12.77; df = 2, 36; $p < .001$). The significant conditions effect was tested further by the Newman-Keuls procedure which showed that performance on both paragraph elaboration conditions was significantly better than performance on the Word Mediation condition (for Syntactic Paragraph $p < .01$; for Semantic Paragraph $p < .01$), but that the difference between the paragraph elaboration conditions was not significant ($p > .05$).

Means for the number correct on reversal are shown in Table 7. A Condition x Sex x Age analysis of variance was conducted on the data of this table, and the summary table for this analysis is shown in Table 8. As shown in Table 8, this analysis produced significant conditions and significant age main effects. The sex variable was found to be nonsignificant. However, the Conditions x Sex interaction was significant. No other significant interactions were found. Analyses of the simple effects of conditions within sex showed that there was a highly significant difference for boys' performances across the three conditions and a lesser effect for girls (see Table 8). Newman-Keuls analyses of conditions within each sex found that for both sexes

TABLE 7

Mean Number Correct on Reversal - Study III

	Boys		Girls		Combined	
	Young	Old	Young	Old	Young	Old
Word Mediation:						
$\bar{X}$	2.25	5.25	5.00	6.25	3.63	5.75
SD	2.06	0.96	2.16	1.26	2.45	1.16
Semantic Paragraph:						
$\bar{X}$	7.00	8.00	5.50	7.50	6.25	7.75
SD	1.41	0.00	2.08	0.58	1.83	0.46
Syntactic Paragraph:						
$\bar{X}$	7.75	7.25	7.25	8.00	7.50	7.63
SD	0.50	0.30	0.30	0.00	0.76	0.74

TABLE 8

Summary Table for ANOVA of Number Correct on Reversal - Study III

Source	SS	df	MS	F	p
Condition (A)	74.29	2	37.15	22.10	.001
Age (B)	18.75	1	18.75	11.16	.005
Sex (C)	1.33	1	1.33	1.00	n.s.
Cond. x Age	8.37	2	4.19	2.49	.10
Cond. x Sex	16.79	2	8.40	4.99	.025
Age x Sex	.08	1	.08	1.00	n.s.
C x A x S	5.55	2	2.77	1.65	n.s.
Error	60.50	36	1.68	----	----
Total	185.67	47	----	----	----

Simple effects:

Source	SS	df	MS	F	p
C for a_1 (Boys)	75.00	2	37.50	22.32	.001
C for a_2 (Girls)	16.08	2	8.04	4.79	.025
Within Cell	60.50	36	1.68	----	----

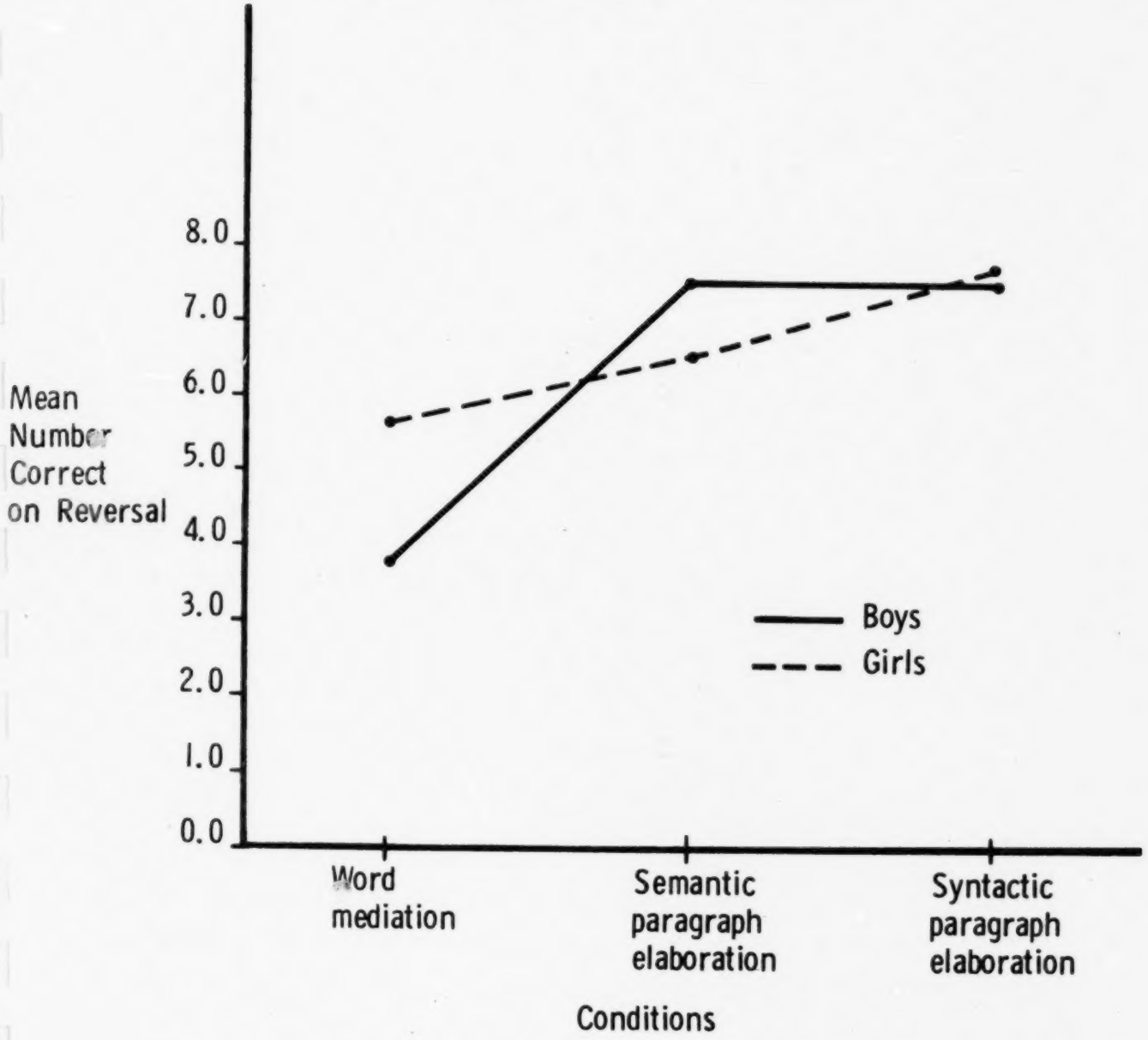
the Word Mediation condition resulted in a significantly lower mean number correct on reversal than did Syntactic Paragraph Elaboration, and that, for the boys only, performance in the Word Mediation condition was significantly worse than Semantic Paragraph Elaboration as well. Inspection of Table 7 indicates that the lack of a significant difference between Word Mediation and Semantic Elaboration for girls is attributable to a weakness in the younger group of Semantic Elaboration girls (actually one individual's performance), coupled with the unexpectedly strong performance on Word Mediation reversal by both the older, and especially, the younger girls (see also Figure 1).

The question is, what restriction should be placed on the conclusion that syntactic elaboration, in general, facilitates reversal of paired-associates over labeling? On the basis of all available evidence (Turnure & Walsh, 1971; Turnure, 1971; this report, Study I), this conclusion must be considered valid, but with the caution that extraordinary efforts by Word Mediation subjects, coupled on occasions with the unusual poor performance of an elaboration condition subject, can minimize condition differences to the point where statistical significance may be lost, particularly with small groups. Perfect reversal performance in the paragraph conditions substantiates the preceding argument for the general superiority of syntactic elaboration over labeling. Nine of the 16 Semantic Paragraph subjects (56%) reversed errorlessly, as did 11 of the 16 Syntactic Paragraph subjects (69%). As for the Word Mediation condition, only one child in Study III, an older girl, was able to perform perfect reversal (7%). Considering the perfect performances on reversal of younger and older elaboration subjects, 50% (8 of 16) of the younger subjects, and 75% (12 of 16) of the older subjects reversed errorlessly.

Figure 1

Mean Number Correct on Reversal for Boys and Girls

in Three Experimental Conditions in Study III



Discussion

The findings of Study III show, once again, that embedding the stimuli to be associated in a syntactic context significantly facilitates both the acquisition and reversal of paired-associates over conditions of restricted, non-syntactic word mediation. Mean trials to criterion for each condition with the young and old subjects combined were very similar to those of the respective experimental conditions in Study I. In general, however, the youngest Study III subjects, when considered as a group, performed somewhat worse than the oldest Study III subjects, as well as slightly worse than the older first graders in Study I; none of these differences were statistically significant. As for the older nursery subject, when compared with their MA matches of Study I, they appear to have performed a little better in the Word Mediation condition and a little worse in the two paragraph elaboration conditions (see Tables 2 and 6).

Reversal performance for the older nursery subjects almost exactly replicates that of the first graders in Study I (see Tables 2 and 7). The reversal performance of the younger nursery school subjects was significantly poorer than that of the older nursery subjects, suggesting that these younger children may not have yet attained the level of verbal flexibility required by the reversal task, unlike the older nursery and first graders of MA 6.5 who seem to have done so. Nevertheless, the facilitory effect of syntactic elaboration over labeling experience alone was as evident in the younger children as in the older. In fact, the advantage in performing the reversal task which the older subjects seem to have is found primarily in the most difficult (empirically defined) Word Mediation condition, and is much

less evident in the paragraph elaboration conditions.

In summary, the results of Studies I and III indicated that acquisition performance on the four pairs of paired-associates, while dramatically affected by the presence or absence of syntactic elaboration, was affected relatively little by differences in MA, CA, or IQ, as represented by the subject groups tested. This, however, was not so clearly the case for the reversal phase of the task, where the younger subjects, both in MA and CA, seemed slightly less able to perform the task of reversal, especially in the labeling condition. It might be argued that these younger children, having for the most part just attained a completely developed syntactic system (Ervin & Miller, 1963), should be less able to take advantage of the syntactic facilitation provided to them. Indeed, their performance was somewhat poorer than their older nursery school companions. However, the differences in their performance in the syntactic elaboration conditions were quite small and considerably less than in the more difficult labeling or Word Mediation condition.

Summarizing the results of the three studies reported, we have found (Study I and III) that the acquisition and reversal of paired-associates in normal children from three to seven years of age was significantly facilitated by initially presenting the associates in extended and grammatically appropriate verbal contexts. Further, it was found that the more extensive the verbal context (up to two sentences), the better the acquisition of the associations, but extent of context had no effect on reversal of associations acquired in context. These findings replicate quite precisely those previously reported with mentally retarded subjects (Turnure & Walsh, 1971; Turnure, 1971), and

so extend the generality of the effects and provide some support for the hypotheses and explanations generated by the prior findings.

Additional analyses: Normal-retardate comparisons. As was indicated in the introduction to this report, the present series of studies was designed, at least in part, to provide data suitable for comparison of normal and retarded children's performance on the paired-associate task under syntactic elaboration or non-elaboration (labeling) conditions. Thus the normal children of Studies I and II and the older nursery school children of Study III were selected to provide at least rough MA matches for, and thereby to permit comparisons with, the retarded subjects tested by Turnure (Turnure & Walsh, 1971; Turnure, 1971). Consequently, a number of statistical analyses comparing data from these several studies have been carried out in order to investigate empirical differences that may exist among these groups of children. Mean trials to criterion, mean number correct on reversal, and percentage correct on reversal for all of these groups are shown in Table 9.

Four-pair comparisons. A series of comparisons were possible among Studies I and III and the first Turnure study (Turnure & Walsh, 1971; also see Turnure & Walsh, 1970, Study I) since the subjects in all of these studies were tested on four stimulus-response pairs with nearly identical testing procedures. In addition, groups in each study had been tested under similar experimental conditions (Studies I and III: Word Mediation, Semantic Paragraph Elaboration, Syntactic Paragraph Elaboration; Turnure & Walsh, 1971: Word Mediation, combined Paragraph Elaboration). Figure 2 presents the acquisition results graphically.

Paragraph elaboration conditions data were combined in each study and compared with Word Mediation performance in a 2 (condition) x 4

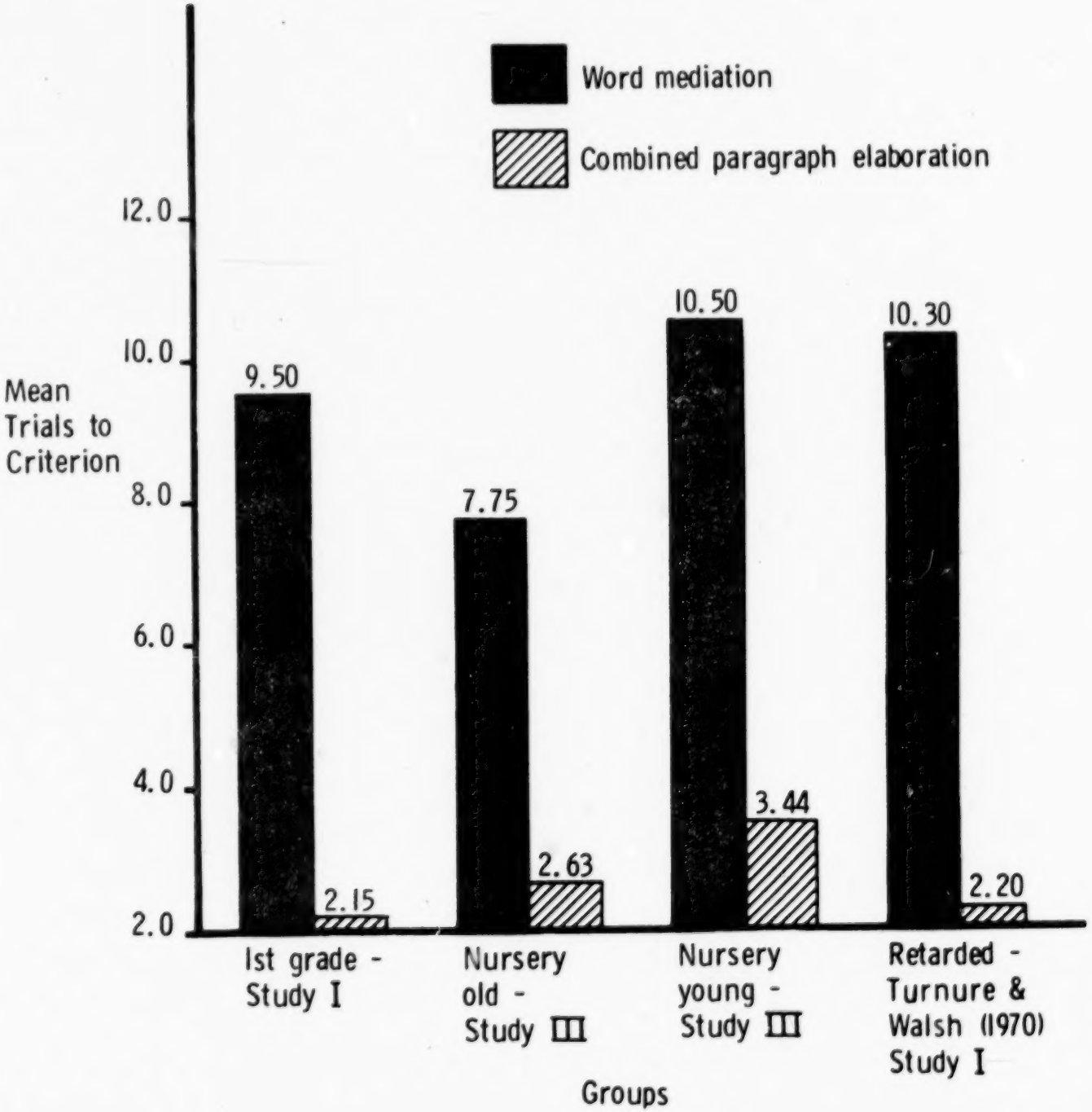
TABLE 9

Normal - Retardate Comparisons:
Mean Trials to Criterion and Mean Number Correct and Percentage Correct on Reversal

	Mean Trials to Criterion	Mean Number Correct On Reversal	Percentage Correct On Reversal
Four - Pair Comparisons:			
1st grade Study I			
Word Mediation	9.50	5.90	73.75
Paragraph Elaboration	2.15	7.85	98.12
Nursery-Old Study III			
Word Mediation	7.75	5.75	71.87
Paragraph Elaboration	2.63	7.67	95.87
Nursery-Young Study III			
Word Mediation	10.50	3.63	45.37
Paragraph Elaboration	3.44	6.88	86.00
Retarded - Turnure & Walsh (1971)			
Word Mediation	10.30	4.00	50.00
Paragraph Elaboration	2.20	7.90	98.75
Eight - Pair Comparisons:			
1st grade			
Sentence Elaboration	4.25	15.50	98.87
Sentence Paragraph	2.92	15.92	99.50
Syntactic Paragraph	2.33	15.67	97.93
Retarded - Turnure (1971)			
Sentence Elaboration	6.00	15.38	98.87
Semantic Paragraph	3.13	15.38	96.12
Syntactic Paragraph	3.38	15.25	95.31

Figure 2

Mean Trials to Criterion in Word Mediation and Combined Paragraph Elaboration Conditions for Four-Pair Comparisons



(group) analysis of variance with unequal cell frequencies (Winer, 1962, sec. 6.3). Specifically, the four groups whose acquisition performances were compared were the present Study I; Study III, older subjects; Study III, younger subjects; and the Turnure and Walsh (1971) mentally retarded subjects. This analysis produced only a significant conditions effect ($F = 78.35$; $df = 1, 90$; $p < .001$), affirming the results obtained independently in each of these studies of the powerful effects of syntactic elaboration on the acquisition of paired-associates over the effects of mere labeling. A similar 2 x 4 analysis of variance was performed on the number correct on reversal for each of the same four groups, again comparing the Word Mediation data with the combined paragraph elaboration conditions data. Mean reversal scores are graphed in Figure 3, and the summary table for this analysis of variance is shown in Table 10. Both the conditions and groups main effects as well as the Conditions x Groups interaction were found significant. The simple effects of conditions within each group was highly significant for every group indicating that the facilitory effect of syntactic elaboration over labeling alone on reversal performance was consistent for all groups compared, and therefore not the source of the interactions (see Table 10). The simple effects of groups within conditions, however, was significant only for the Word Mediation condition. A further analysis of the mean number of correct responses on reversal among groups, using a Newman-Keuls test for differences among means, yielded the results shown in Table 11. The normal first graders and the older nursery school groups did not differ from one another, but both were significantly superior to the educable mentally retarded and the younger

Figure 3

Mean Number Correct on Reversal in Word Mediation and Combined Paragraph Elaboration Conditions for Four-Pair Comparisons

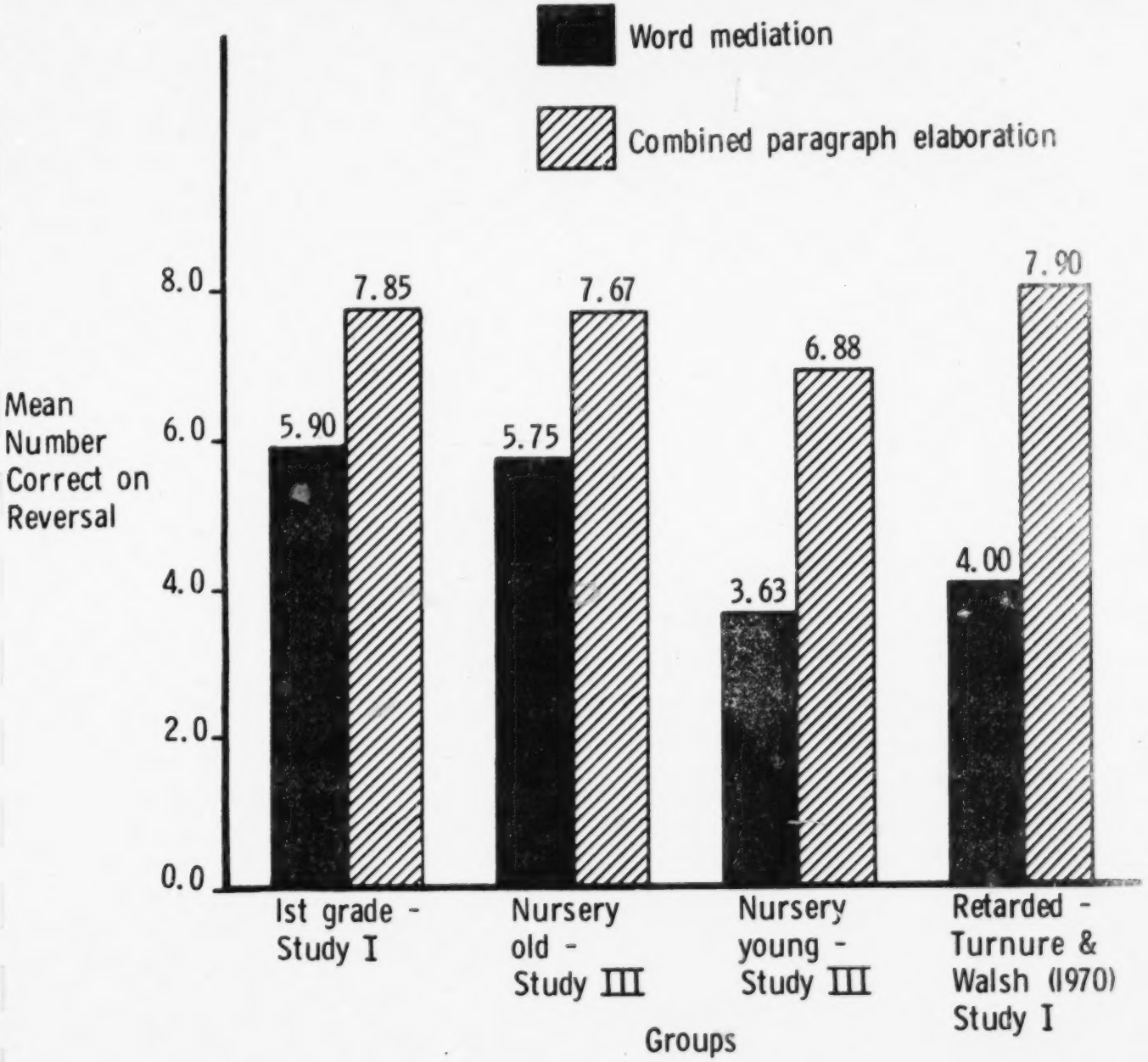


TABLE 10

Summary Table for ANOVA of Number Correct on Reversal Comparing Studies Using Four Stimulus-Response Pairs

Source	SS	df	MS	F	p
Conditions (A)	166.37	1	166.37	91.92	.001
Groups (B)	36.72	3	12.24	7.09	.001
Cond. x Groups	15.78	3	5.26	2.91	.05
Within Cell	162.91	90	1.81	----	----
Simple Effects:					
Source					
B for a_1 (Word)	45.16	3	15.05	8.31	.001
B for a_2 (Paragraph)	7.34	3	2.45	1.35	n.s.
Within Cell	162.91	90	1.81	----	----
Source					
A for b_1 (1st grade)	20.82	1	20.82	11.50	.005
A for b_2 (Nursery-old)	20.17	1	20.17	11.14	.005
A for b_3 (Nursery-young)	57.87	1	57.87	31.97	.001
A for b_4 (Retarded)	83.41	1	83.41	46.08	.001
Within Cell	162.91	90	1.81	----	----

TABLE 11

Newman-Keuls Analysis of Number Correct on

Reversal for Word Mediation Condition: Normal - Retardate Comparisons

MS_B for a_1	A	B	C	D
	Young-Nursery	Retarded	Old-Nursery	Normal-1st grade
ordered means:	3.63	4.00	5.75	5.90

		A	B	C	D
differences:	a	---	.37	2.12	2.27
	b	---	---	1.75	1.90
	c	---	---	---	.15
	d	---	---	---	---

$$S_{\bar{X}} = \sqrt{MS_{w\ cell} / \bar{n}_h} = \sqrt{1.81 / 10.96} = .41$$

	r = 2	r = 3	r = 4
$q_{.99}(r, 90)$	3.76	4.28	4.60
$S_{\bar{X}}\, q_{.99(r,90)}$	1.54	1.75	1.89

		A	B	C	D
outcome of tests:	a	---	n.s.	.01	.01
	b	---	---	.01	.01
	c	---	---	---	n.s.
	d	---	---	---	---

nursery groups. The educable mentally retarded and the younger nursery groups did not differ from one another.

Eight-pair comparisons. A second series of additional statistical comparisons was made on the data obtained in the present Study II from first grade normal subjects and that obtained in the Turnure (1971; also see Turnure & Walsh, 1970, Study II) study with educable mentally retarded subjects. Both groups of subjects had been tested on the longer, eight-pair list of paired-associates under very similar procedures thereby permitting such comparisons. Although the Turnure study investigated performance under Word Mediation, the Word Mediation condition had not been included in the present Study II, and consequently in the analyses described here, only data from the Sentence Elaboration and the two paragraph elaboration conditions of both subject groups are considered.

Table 12 presents the mean trials to criterion results (also see Figure 4) which were entered into a 2 (group) x 3 (condition) x 2 (sex) analysis of variance. This analysis produced a significant groups main effect ($F = 5.05$; $df = 1, 48$; $p < .05$). No interactions were significant, however, and it can be concluded that the retarded subjects were performing more poorly than the normal subjects in general. In fact, with the exception of the retarded girls in the Semantic Paragraph condition, they performed more poorly at every point of comparison although both groups were at approximately an MA level of 6.5 years. However, it should be noted in Table 12 that the main differences observed were quite small, averaging overall about one trial. The only other significant finding of this analysis of variance was for the conditions main effect ($F = 10.18$; $df = 2, 48$;

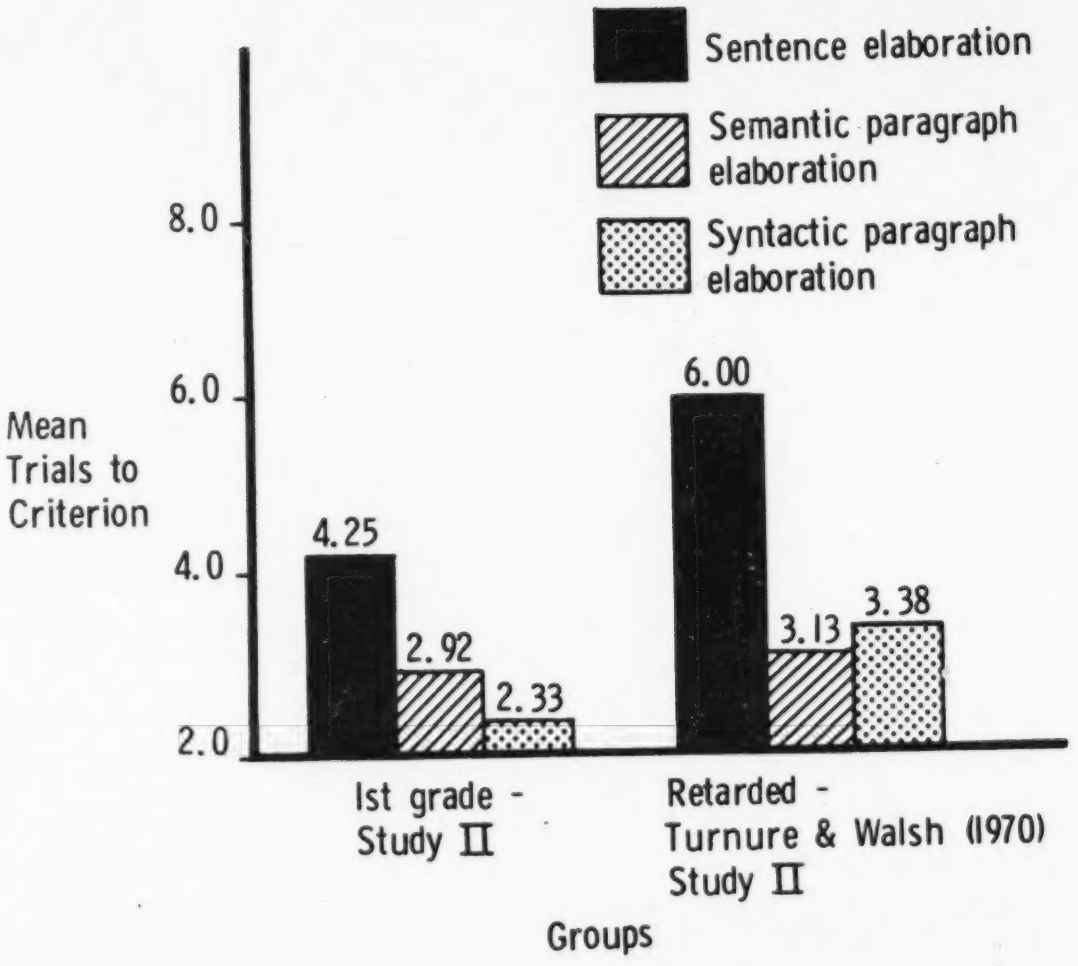
TABLE 12

Means and Standard Deviations for Trials to Criterion and Reversal Number Correct for Studies Using Eight Stimulus - Response Pairs

	Trials to Criterion		Reversal Number Correct	
	Study II-1st graders	Retarded	Study II-1st graders	Retarded
Sentence Elaboration:				
Boys $\bar{X}$	3.83	4.50	15.67	15.25
SD	2.15	3.70	0.82	0.96
Girls $\bar{X}$	4.67	7.50	15.33	15.50
SD	1.51	3.32	0.52	1.00
Combined $\bar{X}$	4.25	6.00	15.50	15.38
SD	1.82	3.63	0.67	0.92
Semantic Paragraph:				
Boys $\bar{X}$	2.83	3.75	15.83	15.25
SD	0.75	0.96	0.41	0.96
Girls $\bar{X}$	3.00	2.50	16.00	15.50
SD	0.89	0.58	0.00	0.58
Combined $\bar{X}$	2.92	3.13	15.92	15.38
SD	0.79	0.99	0.29	0.74
Syntactic Paragraph:				
Boys $\bar{X}$	2.00	4.00	15.50	15.00
SD	0.00	1.63	0.55	0.82
Girls $\bar{X}$	2.67	2.75	15.83	15.50
SD	0.82	1.50	0.41	1.00
Combined $\bar{X}$	2.33	3.38	15.67	15.25
SD	0.65	1.60	0.49	0.89

Figure 4

Mean Trials to Criterion in Three Experimental Conditions for Eight-Pair Comparisons



$p < .01$). Further analysis using a Newman-Keuls procedure was again performed, and the Sentence Elaboration condition emerged as having significantly poorer performance than either of the paragraph elaboration conditions which were not significantly different from each other.

In addition to the above parametric analyses of the acquisition data, a chi-square analysis was made of the number of subjects who performed perfectly on acquisition under each of the three conditions for the two subject groups. The percentage of subjects performing perfectly increased nearly linearly (see Table 13) from the Sentence to the Semantic to the Syntactic elaboration conditions for both subject groups. Although a greater percentage of normal subjects performed perfectly in each condition, a chi-square test based on these data was not significant ($x^2 = .08$, $df = 2$; n.s.).

A Groups x Conditions x Sex analysis of variance was also performed on the reversal scores. Mean scores for the reversal are shown in Table 12 (see also Figure 5), and observation of these scores reveals that the means for all groups are very near 16, the maximum possible correct. This apparent consistency across all groups, conditions and sexes is reflected in the results of the analysis of variance, which produced only a groups main effect of marginal significance ($F = 4.00$; $df = 1, 48$; $p < .10$). No other main effect or interaction approached significance. This apparent lack of difference in reversal between normal and retarded subjects who had been given eight paired-associates was further substantiated by a non-significant chi-square analysis of the number of these subjects who reversed perfectly ($x^2 = .68$; $df = 2$; n.s.). The percentage of subjects who reversed perfectly in each group and condition was generally, although not in every case, higher than the percentage who had performed perfectly in acquisition (see

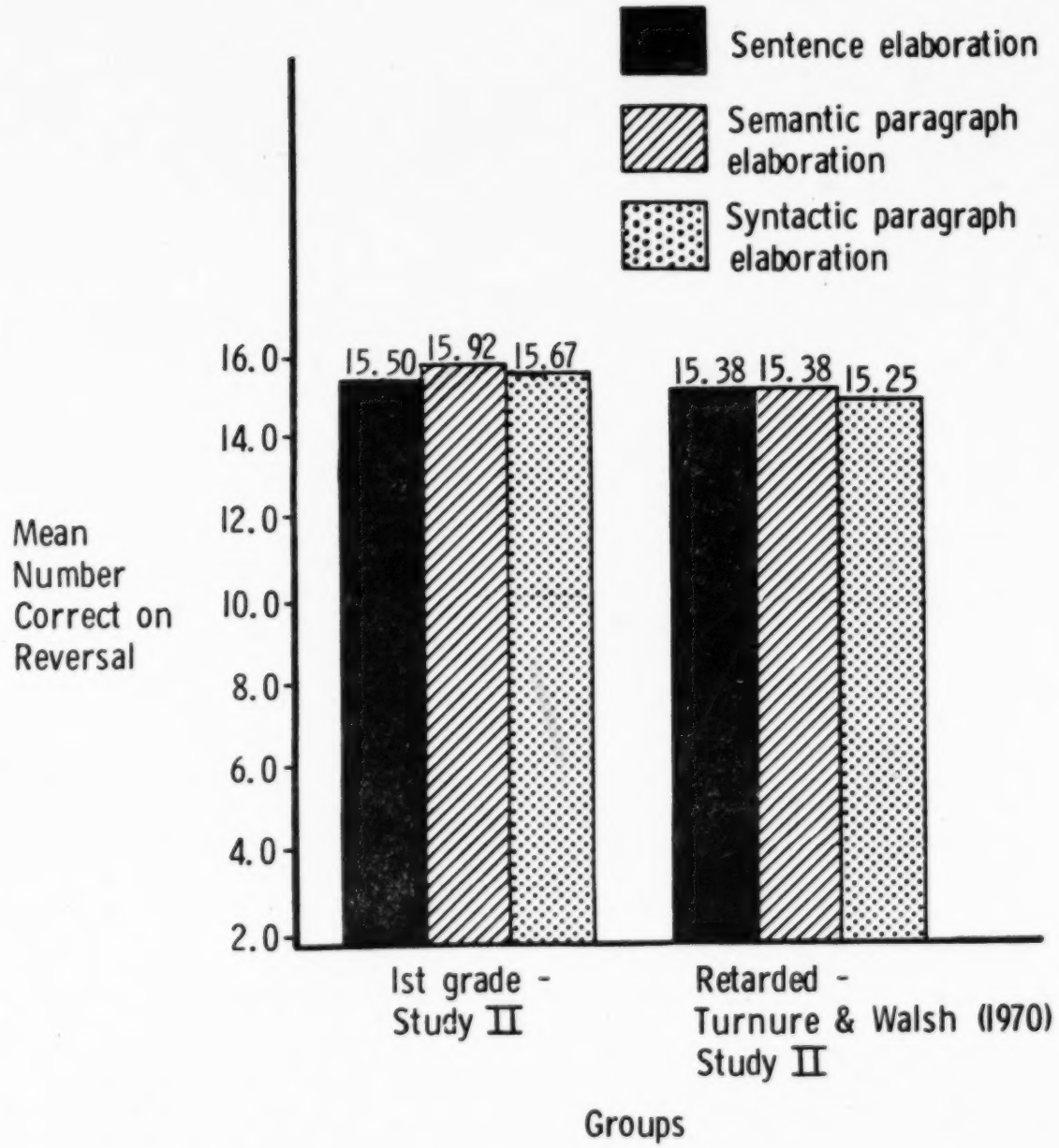
TABLE 13

Percentage of Subjects who Performed Perfectly on Acquisition

	Sentence	Semantic	Syntactic
Retarded	12%	25%	50%
1st-grade	25%	33%	75%

Figure 5

Mean Number Correct on Reversal in Three Experimental Conditons for Eight-Pair Comparisons



Tables 13 and 14). The differences between the groups' or conditions' perfect reversal performance were not nearly as clear or consistent as they had been for perfect acquisition.

Discussion: Normal - Retardate comparisons

Statistical comparisons of the data from Studies I and III and that from the Turnure and Walsh study (1971) have been reported above (4-pair comparisons). These additional analyses, now including a group of educable mentally retarded children, support the conclusion that acquisition performance was relatively unaffected by differences in either MA, CA, IQ or practical experience with syntactic usage, within the limits of the groups tested. Once again, the major difference in performance occurred between those subjects having syntactic versus those subjects having non-syntactic training. No group differences emerged in the analyses performed on trials to criterion.

With the inclusion of the retarded subjects in the comparative analyses of the reversal number correct the picture becomes more complex, and differences between group performances become apparent. Once more the young nursery subjects performed less well than the older nursery or normal first graders in the Word Mediation condition. Similarly, in this condition the retarded subjects performed less well than either of their MA matches, i.e., the older nursery or normal first-graders. No significant difference in reversal performance, however, was found between the retarded subjects and the young nursery children, nor between the older nursery subjects and the normal first graders (see Figure 3). Figure 3 clearly shows that only in the Word Mediation condition do young nursery and retarded subjects perform at a comparable level, and that their performance is at a level considerably lower than that of the other two

TABLE 14

Percentage of Subjects who Performed Perfectly on Reversal

	Sentence	Semantic	Syntactic
Retarded	62%	50%	50%
1st-grade	58%	91%	66%

groups. In the paragraph elaboration conditions no such differences emerge, and all four groups appear to be performing at approximately the same mean level. However, that it is the older CA ($\bar{X}$ = 9.7) retarded children who benefit the most from the syntactic elaboration, and the youngest CA ($\bar{X}$ = 3.8) who benefit the least, seems to raise again the possibility that experience in syntactic usage is an important variable in the degree to which syntactic elaboration facilitates reversal of paired-associates.

Increasing the task difficulty by doubling the number of paired-associates to be learned from four to eight resulted in differential performance between the retarded and normal subjects, who again were of approximately the same (8-pair comparisons). This is the first instance in the series of comparisons described here where differential acquisition performance has emerged between subject groups. Interestingly, this difference emerged in comparison which included only the three syntactic elaboration conditions: Sentence Elaboration, Semantic and Syntactic Paragraph Elaboration. Syntactic elaboration, then, does not appear to be sufficiently powerful to bring the performance of retarded subjects up to a level of performance equivalent to that of normal subjects of the same MA when the memory load is increased to this degree. However, it should be noted that the overall mean difference between the groups was only one trial to criterion. This result, then, may be of little practical significance unless it reflects the point at which increasing the memory load increases the differential in the groups' relative performances, a matter which can be readily clarified. The results from the reversal task with eight pairs showed that subjects performed remarkably well, with both groups averaging approximately 15 out of the maximum 16 correct reversals. This

extremely good performance may be surprising at first glance, since it is in the reversal phase that the clearest differences among groups seem to emerge in the four-pair task. However, when it is recalled that these group differences in the four-pair task occurred in the Word Mediation or non-syntactic condition only, then the results from the eight-pair task appear consistent with the reversal findings of the four-pair studies. That is to say, syntactic elaboration, whether in a single-sentence form or short paragraph form, has a tremendously facilitory effect on reversal.

Finally, despite the sizeable facilitating effect of syntactic elaboration in general, the present comparative results confirm the acquisition findings in the two Turnure studies (Turnure & Walsh, 1971; Turnure, 1971) as well as those of the present Study II, which show that paragraph elaboration techniques significantly enhance speed of learning in comparison to sentence elaboration.

Footnotes

[1]The research reported in Studies II and III, and the preparation of this paper were supported in part by a grant to the Research and Development Center in Education of the Handicapped, Department of Special Education, University of Minnesota. The Center is funded by a grant (OEG-0-9332189-4533-032) from the Bureau of Education of the Handicapped, U. S. Office of Education. The authors would like to thank the Minneapolis Public Schools, the Columbia Heights Public Schools Independent District No. 13, and the University of Minnesota Nursery School for their cooperation. Appreciation is also extended to Mrs. Rosalie Watts for her assistance in testing subjects in Study I and to Drs. S. Jay Samuels, Arthur M. Taylor, and David Feldman for their critical reading of the manuscript.

[2]It should be noted at this point that henceforth the verbal manipulation involving syntactic constructions previously referred to as "mediational" will be designated "elaborative" (e.g., syntactic elaboration, sentence elaboration, syntactic paragraph elaboration, etc.), in accordance with Rohwer's recent analysis of the methodological and theoretical distinctions between verbal mediation and verbal elaboration (Rohwer, 1970).

References

Anderson, R. C. Control of student mediating processes during verbal learning and instruction. Review of Educational Research, 1970, 40, 349-369.

Asch, S. E. A reformulation of the problem of associations. American Psychologist, 1969, 24, 92-102.

Asch, S. E., & Ebenholtz, M. The principle of associative symmetry. Proceedings of the American Philosophical Society, 1962, 106, 135-163.

Blumenthal, A. L. Prompted recall of sentences. Journal of Verbal Learning and Verbal Behavior, 1967, 6, 203-206.

Blumenthal, A. L. & Boakes, R. Prompted recall of sentences, a further study. Journal of Verbal Learning and Verbal Behavior, 1967, 6, 674-676.

Bobrow, S. A. & Bower, G. H. Comprehension and recall of sentences. Journal of Experimental Psychology, 1969, 80, 455-461.

Bower, G. H. Imagery as a relational organizer in associative learning. Journal of Verbal Learning and Verbal Behavior, 1970, 9, 529-533.

Davidson, R. E. Mediation and ability in paired associate learning. Journal of Educational Psychology, 1964, 55, 352-356.

Ervin, S. M. & Miller, W. R. Language development. In H. W. Stevenson (Ed.), Sixty-second yearbook of the national society for the study of education, part I: Child Psychology. Chicago: University of Chicago Press, 1963. Pp. 108-138.

Jenkins, J. Individual differences in verbal learning. In R. M. Gagne´ (Ed.), Learning and individual differences. Columbus, Ohio: Charles E. Merrill Books, Inc., 1967. Pp. 45-65.

Jensen, A. R. & Rohwer, W. D., Jr. Verbal mediation in paired-associate and serial learning. Journal of Verbal Learning and Verbal Behavior, 1963, 1, 346-352. (a)

Jensen, A. R., & Rohwer, W. D. Jr. The effect of verbal mediation on the learning and retention of paired-associates by retarded adults. American Journal of Mental Deficiency, 1963, 68, 80-84. (b)

McNeill, D. The creation of language by children. In J. Lyons and R. J. Wales (Eds.), Psycho-linguistic papers. Edinburgh: University Press, 1966. Pp. 99-132.

Milgram, N. A. The effects of M. A. and I. Q. on verbal mediation in paired associate learning. The Journal of Genetic Psychology, 1968, 113, 129-143. (a)

Milgram, N. A. The effect of verbal mediation in paired-associate learning in trainable retardates. American Journal of Mental Deficiency, 1968, 72, 518-524. (b)

Milgram, N. A. Effect of sentence recital on implicit mediation in paired-associate learning. Journal of Verbal Learning and Verbal Behavior, 1968, 7, 714-721. (c)

Paivio, A. Imagery and language. Department of Psychology Research Bulletin, No. 167, University of Western Ontario, London, Canada, 1970.

Rohwer, W. D. Mental elaboration and proficient learning. In J. P. Hill (Ed.), Minnesota symposia on child psychology. Vol. 4, Minneapolis, Minnesota: University of Minnesota Press, 1970.

Suzuki, N., and Rohwer, W. D., Jr. Deep structure in the noun-pair learning of children and adults. Child Development, 1969, 40, 911-919.

Taylor, A. M. Visual imagery instruction and action versus non-action situations relative to recall by children. Final report of U. S. Office of Education grant #OEG-5-9-245000-0023, May, 1970.

Turnure, J. E. & Walsh, M. K. Extended verbal mediation in the learning and reversal of paired-associates by educable mentally retarded children. American Journal of Mental Deficiency, 1971, in press. (Also reported in Turnure & Walsh, 1970, Study I).

Turnure, J. E. Types of verbal elaboration in the paired-associate performance of mental retardates. Submitted for publication. (Also reported in Turnure & Walsh, 1970, Study II).

Turnure, J. E. & Walsh, M. K. The effects of varied levels of verbal mediation on the learning and reversal of paired-associates by educable mentally retarded children. Research and Development Center in Education of Handicapped Children Research Report No. 5, 1970, University of Minnesota, Minneapolis.

Winer, B. J. Statistical principles in experimental design. New York: McGraw-Hill, 1962.

TECHNICAL REPORTS

University of Minnesota Research, Development and Demonstration
Center in Education of Handicapped Children

(Place of publication shown in parentheses where applicable)

1. C. Clark & J. Greco. MELDS (Minnesota Early Language Development Sequence) Glossary of Rebuses and Signs. Occasional Paper #18. June 1973.

2. J. Turnure. Interrelations of orienting responses, response latency and stimulus choice in children's learning. Research Report #52. May 1973.

3. S. Samuels & P. Dahl. Automaticity, Reading and Mental Retardation. Occasional Paper #17. May 1973.

4. S. Samuels & P. Dahl. Relationships among IQ, learning ability, and reading achievement. Occasional Paper #16. May 1973.

5. N. Buium & J. Rynders. The early maternal linguistic environment of normal and Down's Syndrome (Mongoloid) language learning children. Research Report #51. May 1973.

6. T. Archwamety & S. Samuels. A mastery based experimental program for teaching mentally retarded children word recognition and reading comprehension skills through use of hypothesis/test procedures. Research Report #50. May 1973.

7. W. Bart. The process of cognitive structure complexification. Research Report #49. April 1973.

8. B. Best. Classificatory development in deaf children: Research on language and cognitive development. Occasional Paper #15. April 1973.

9. R. Riegel, A. Taylor, & F. Danner. The effects of training in the use of a grouping strategy on the learning and memory capabilities of young EMR children. Research Report #48. April 1973.

10. J. Turnure & M. Thurlow. The latency of forward and backward association responses in an elaboration task. Research Report #47. March 1973.

11. R. Riegel & A. Taylor. Strategies in the classroom: A summer remedial program for young handicapped children. Occasional Paper #14. March 1973.

12. D. Moores. Early childhood special education for the hearing impaired. Occasional Paper #13. February 1973.

13. R. Riegel & A. Taylor. A comparison of conceptual strategies for grouping and remembering employed by educable mentally retarded and non-retarded children. Research Report #46. February 1973.

14. J. Rynders. Two basic considerations in utilizing mothers as tutors of their very young retarded or potentially retarded children. Occasional Paper #12. January 1973.

15. R. Bruininks, J. Rynders & J. Gross. Social acceptance of mildly retarded pupils in resource rooms and regular classes. Research Report #45. January 1973.

16. J. Turnure & M. Thurlow. The effects of interrogative elaborations on the learning of normal and EMR children. Research Report #44. January 1973. (Proceedings of the International Association for the Scientific Study of Mental Deficiency, inpress.)

17. J. Turnure & S. Samuels. Attention and reading achievement in first grade boys and girls. Research Report #43. November 1972. (Journal of Educational Psychology, in press).

18. R. Riegel, A. Taylor, S. Clarren, & F. Danner. Training educationally handicapped children to use associative grouping strategies for the organization and recall of categorizable material. Research Report #42. November 1972.

19. R. Riegel, F. Danner, & A. Taylor. Steps in sequence: Training educationally handicapped children to use strategies for learning. Development Report #2. November 1972.

20. A. Taylor, M. Thurlow, & J. Turnure. The teacher's introduction to: the Math Vocabulary Program. Development Report #1. March 1973.

21. J. Turnure & M. Thurlow. The effects of structural variations in elaboration on learning by normal and EMR children. Research Report #41. September 1972.

22. A. Taylor & N. Bender. Variations of strategy training and the recognition memory of EMR children. Research Report #40. September 1972. (American Educational Research Journal, in press).

23. D. Moores, C. McIntyre, & K. Weiss. Evaluation of programs for hearing impaired children: Report of 1971-1972. Research Report #39. September 1972.

24. R. Rubin. Follow-up of applicants for admission to graduate programs in special education. Occasional Paper #11. July 1972.

25. D. Moores. Communication - Some unanswered questions and some unquestioned answers. Occasional Paper #10. July 1972.

26. A. Taylor & S. Whitely. Overt verbalization and the continued production of effective elaborations by EMR children. Research Report #38. June 1972. (American Journal of Mental Deficiency, in press).

27. R. Riegel. Measuring educationally handicapped children's organizational strategies by sampling overt groupings. Research Report #37. May 1972.

28. E. Gallistel, M. Boyle, L. Curran, & M. Hawthorne. The relation of visual and auditory aptitudes to first grade low readers' achievement under sight-word and systematic phonic instruction. Research Report #36. May 1972.

29. E. Gallistel & T. Fischer. Decoding skills acquired by low readers taught in regular classrooms using clinical techniques. Research Report #35. May 1972.

30. J. Turnure & M. Thurlow. Verbal elaboration in children: Variations in procedures and design. Research Report #34. March 1972.

31. D. Krus & W. Bart. An ordering-theoretic method of multidimensional scaling of items. Research Report #33. March 1972.

32. J. Turnure & S. Larsen. Effects of various instruction and reinforcement conditions on the learning of a three-position oddity problem by nursery school children. Research Report #32. March 1972.

33. J. Turnure & S. Larsen. Outerdirectedness in mentally retarded children as a function of sex of experimenter and sex of subject. Research Report #31. March 1972.

34. J. Ryuders & J. Horrobin. A mobile unit for delivering educational services to Down's Syndrome (Mongoloid) infants. Research Report #30. January 1972. (Presented at Council for Exceptional Children, Special National Conference, Memphis, December, 1971).

35. F. Danner & A. Taylor. Pictures and relational imagery training in children's learning. Research Report #29. December 1971. (Journal of Experimental Child Psychology, in press).

36. J. Turnure & M. Thurlow. Verbal elaboration phenomena in nursery school children. Research Report #28. December 1971. (Study II: Proceedings of 81st Annual Convention of the American Psychological Association, in press).

37. D. Moores & C. McIntyre. Evaluation of programs for hearing impaired children: Progress report 1970-1971. Research Report #27. December 1971.

38. S. Samuels. Success and failure in learning to read: A critique of the research. Occasional Paper #9. November 1971. (In N. Kling, the Literature of Research in Reading with Emphasis on Modes, Rutgers University, 1971).

39. S. Samuels. Attention and visual memory in reading acquisition*. Research Report #26. November 1971.

40. J. Turnure & M. Thurlow. Verbal elaboration and the promotion of transfer of training in educable mentally retarded. Research Report #25. November 1971. (Journal of Experimental Child Psychology, 1973, 15, 137-148.

41. A. Taylor, H. Josberger, & S. Whitely. Elaboration training and verbalization as factors facilitating retarded children's recall. Research Report #24. October 1971. (Journal of Educational Psychology, in press).

42. W. Bart & D. Krus. An ordering-theoretic method to determine hierarchies among items. Research Report #23. September 1971.

43. A. Taylor, H. Josberger, & J. Knowlton. Mental elaboration and learning in retarded children. Research Report #22. September 1971. (Mental Elaboration and Learning in EMR Children. American Journal of Mental Deficiency, 1972, 77, 69-76).

44. J. Turnure & S. Larsen. Outerdirectedness in educable mentally retarded boys and girls. Research Report #21. September 1971. (American Journal of Mental Deficiency, in press).

45. R. Bruininks, T. Glaman, & C. Clark. Prevalence of learning disabilities: Findings, issues, and recommendations. Research Report #20. June 1971. (Presented at Council for Exceptional Children Convention, Miami Beach, April, 1971).

46. M. Thurlow & J. Turnure. Mental elaboration and the extension of mediational research: List length of verbal phenomena in the mentally retarded. Research Report #19. June 1971. (Journal of Experimental Child Psychology, 1972, 14, 184-195.

47. G. Siegel. Three approaches to speech retardation. Occasional Paper #8. May 1971.

48. D. Moores. An investigation of the psycholinguistic functioning of deaf adolescents. Research Report #18. May 1971. (Exceptional Children, May 1970, 36, 645-652).

49. D. Moores. Recent research on manual communication. Occasional Paper #7. April 1971. (Keynote Address, Division of Communication Disorders, Council for Exceptional Children Annual Convention, Miami Beach, April, 1971).

50. J. Turnure, S. Larsen, & M. Thurlow. Two studies on verbal elaboration in special populations. I. The effects of brain injury II. Evidence of transfer of training. Research Report #17. April 1971. (Study I: American Journal of Mental Deficiency, in press).

51. R. Bruininks & J. Ryuders. Alternatives to special class placement for educable mentally retarded children. Occasional Paper #6. March 1971. (Focus on Exceptional Children, 1971, 3, 1-12).

52. D. Moores. Neo-oralism and the education of the deaf in the Soviet Union. Occasional Paper #5. February 1971. (Exceptional Children, January 1972, 39, 377-384).

53. D. Feldman, B. Marrinan, & S. Hartfeldt. Unusualness, appropriateness, transformation and condensation as criteria for creativity. Research Report #16. February 1971. (American Educational Research Association Annual Conference, New York, February 1971).

54. P. Broen & G. Siegel. Variations in normal speech disfluencies. Research Report #15. January 1971. (Language & Speech, in press).

55. D. Feldman. Map understanding as a possible crystallizer of cognitive structures. Occasional Paper #4. January 1971. (American Educational Research Journal, 1971, 3, 484-502).

56. J. Rynders. Industrial arts for elementary mentally retarded children: An attempt to redefine and clarify goals. Occasional Paper #3. January 1971.

57. D. Moores. Education of the deaf in the United States. Occasional Paper #2. November 1970. (Moscow Institute of Defectology, 1971, published in Russian).

58. R. Bruininks & C. Clark. Auditory and visual learning in first-, third-, and fifth grade children. Research Report #14. November 1970.

59. R. Bruininks & C. Clark. Auditory and visual learning in first grade educable mentally retarded normal children. Research Report #13. November 1970. (American Journal of Mental Deficiency, 1972, 76, No. 5, 561-567).

60. R. Bruininks. Teaching word recognition to disadvantaged boys with variations in auditory and visual perceptual abilities. Research Report #12. November 1970. (Journal of Learning Disabilities, 1970, 3, 30-39).

61. R. Bruininks & W. Lucker. Change and stability in correlations between intelligence and reading test scores among disadvantaged children. Research Report #11. October 1970. (Journal of Reading Behavior, 1970, 2, 295-305).

62. R. Rubin. Sex differences in effects of kindergarten attendance on development of school readiness and language skills. Research Report #10. October 1970. (Elementary School Journal, 72, No. 5, February 1972).

63. R. Rubin & B. Balow. Prevalence of school learning & behavior disorders in a longitudinal study population. Research Report #9. October 1970. (Exceptional Children, 1971, 38, 293-299).

64. D. Feldman & J. Bratton. On the relativity of giftedness: An empirical study. Research Report #8. August 1970. (American Educational Research Annual Conference, New York, February 1971).

65. J. Turnure, M. Thurlow, & S. Larsen. Syntactic elaboration in the learning & reversal of paired-associates by young children. Research Report #7. January 1971.

66. R. Martin & L. Berndt. The effects of time-out on stuttering in a 12-year-old boy. Research Report #6. July 1970. (Exceptional Children, 1970, 37, 303-304).

67. J. Turnure & M. Walsh. The effects of varied levels of verbal mediation on the learning and reversal of paired-associates by educable mentally retarded children. Research Report #5. June 1970. (Study I: American Journal of Mental Deficiency, 1971, 76, 60-67. Study II: American Journal of Mental Deficiency, 1971, 76, 306-312).

68. J. Turnure, J. Rynders, & N. Jones. Effectiveness of manual guidance, modeling & trial & error learning for inducing instrumental behavior in institutionalized retardates. Research Report #4. June 1970. (Merrill-Palmer Quarterly, 1973, 19, 49-65).

69. J. Turnure. Reactions to physical and social distractors by moderately retarded institutionalized children. Research Report #3. June 1970. (Journal of Special Education, 1970, 4, 283-294).

70. D. Moores. Evaluation of preschool programs: An interaction analysis model. Occasional Paper #1. April 1970. (Keynote Address, Diagnostic Pedagogy, International Congress on Deafness. Stockholm, August 1970, also presented at American Instructors of the Deaf Annual Convention, St. Augustine, Florida, April, 1970).

71. D. Feldman & W. Markwalder. Systematic scoring of ranked distractors for the assessment of Piagetian reasoning levels. Research Report #2. March 1970. (Educational and Psychological Measurement, 1971, 31, 347-362).

72. D. Feldman. The fixed-sequence hypothesis: Individual differences in the development of school related spatial reasoning. Research Report #1. March 1970.